Table of Contents

[Summary 2](#_Toc22652610)

[Work performed 2](#_Toc22652611)

[Performance Data 3](#_Toc22652612)

[Survey 3](#_Toc22652613)

[Detector Performance 3](#_Toc22652614)

[Signature 3](#_Toc22652615)

[Dark Signal 4](#_Toc22652616)

[Signal to Background 4](#_Toc22652617)

[Gold Performance 5](#_Toc22652618)

[Appendix – Electronics Documentation 8](#_Toc22652619)

[9600 X-Ray Controller 8](#_Toc22652620)

[V1 calibration results 9](#_Toc22652621)

# Summary

**Visit duration** Tuesday October 15, 2019 – Wednesday October 16, 2019

Time on site: 13 hrs.

# Work performed

* Carried out 6 month preventative maintenance schedule
	+ Reviewed state of vacuum system:
		- All valves operating correctly
		- Analyzer base pressure at 1.5e-9 Torr
		- Load lock base pressure at 1.3e-9 Torr
		- Cryo pump He operating pressure ~ 75 psig
		- Both cryo cold heads temp metering <15K
		- Oil added to mechanical pump, was low
	+ Replace ion exchange filter and particle filter on Hawk water circulator
	+ Checked for leaks and topped off water level in circulator
	+ Replaced xray anode
	+ Checked all spot sizes and power output
	+ Visually inspected lens screens
	+ Checked all interlocks
	+ Optimized detector voltage for optimum count rate
	+ Captured and loaded new signature file
	+ Tested detector dark signal without HV for noise
	+ Tested fermi edge level for xray window
	+ Calibrated V1 slope and offset
	+ Calibrated detector width
	+ Tested performance of instrument with gold against SPI standards
* Checked operation of ion gauges
* Aligned sputter gun spot with xray analysis spot
* Replaced pump and motor on Hawk water circulator
	+ Flow rate improved from 1.24 to 1.45 GPH
* Checked all motor driver settings
	+ Current settings are working with motors even though current is higher than normal
* Set screw on rotational axis gear extremely loose, causing bouncing and stage to get stuck occasionally
	+ Vented system and tightened set screw, tested rotation before pumping back down

# Performance Data

## Survey



Figure 1 - Survey on gold sample after calibration

Survey recipe:

Spot 800

Res4

1 ev/st

100 ms/step

## Detector Performance

### Signature



Figure 2 - Detector signature capture in unscanned mode, Res4, 600 micron spot, 90 seconds of acquisition

### Dark Signal



Figure 3 - Detector dark signal; captured in unscanned mode, Res4, HV powered off, 60 seconds of acquisition

## Signal to Background



Figure 4 - Fermi edge level data taken with 600 micron spot, Res 4, 60 seconds of acquisition

Signal to Background calculation:

|  |  |  |
| --- | --- | --- |
|  |  | Actual Measurement |
| Peak Valence Band Counts | 13908 |
| Average Background Counts | 57.7 |
| Ratio Peak/Background | 241.0398614 |

\*A ratio of greater than 200:1 signifies an intact xray window

## Gold Performance

Gold Diagonal:



Figure 5 - Performance test on gold; taken with 800 micron spot, Res 4, 60 seconds unscanned acquisition

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Peak ID | Adj'ed Be | Area | FWHM | % Gauss |
| Au4f7 | 83.912 | 1517986 | 1.634 | 86.803 |
| Au4f5 | 87.58 | 1227854 | 1.682 | 84.233 |



Figure 6- Performance test on gold; taken with 600 micron spot, Res 3, 60 seconds unscanned acquisition

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Peak ID | Adj'ed Be | Area | FWHM | % Gauss |
| Au4f7 | 83.952 | 1122483 | 1.273 | 85.37 |
| Au4f5 | 87.597 | 883139 | 1.253 | 84.132 |



Figure 7 - Performance test on gold; taken using 300 micron spot, Res2, 60 seconds of unscanned acquisition

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Peak ID | Adj'ed Be | Area | FWHM | % Gauss |
| Au4f7 | 83.884 | 491568 | 0.903 | 75.196 |



Figure 8 - Performance test on gold; taken with 150 micron spot, Res1, 60 seconds of unscanned acquisition

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Peak ID | Adj'ed Be | Area | FWHM | % Gauss |
| Au4f7 | 83.909 | 63664 | 0.755 | 100 |

Gold Diagonal performance:

|  |
| --- |
| **Unscanned Performance** |
|  | BE - 84 eV | 1 minute acquisition |  |  |  |  |  |
| RESOLUTION | SPOT SIZE |
|   | 150 micron | 300 micron | 600 micron | 800 micron |   |
|   | SPEC | ACT | SPEC | ACT | SPEC | ACT | SPEC | ACT |
| RES 1 - 25eV |   |   |   |   |   |   |   |   |
| RESOLUTION | 0.75 | 0.75 | 0.77 |   | 0.90 |   | 1.00 |   |
| AREA - K CNT | 30.00 | 63.00 | 120.00 |   | 180.00 |   | 250.00 |   |
| RES 2 - 50eV |   |   |   |   |   |   |   |   |
| RESOLUTION | 0.85 |   | 0.90 | 0.90 | 1.05 |   | 1.10 |   |
| AREA - K CNT | 50.00 |   | 200.00 | 491.00 | 280.00 |   | 480.00 |   |
| RES 3 - 100eV |   |   |   |   |   |   |   |   |
| RESOLUTION | 1.20 |   | 1.25 |   | 1.40 | 1.27 | 1.38 |   |
| AREA - K CNT | 70.00 |   | 280.00 |   | 410.00 | 1122.00 | 600.00 |   |
| RES 4 - 150eV |   |   |   |   |   |   |   |   |
| RESOLUTION | 1.42 |   | 1.45 |   | 1.70 |   | 1.65 | 1.64 |
| AREA - K CNT | 80.00 |   | 320.00 |   | 470.00 |   | 700.00 | 1517.00 |

# Appendix – Electronics Documentation

## 9600 X-Ray Controller

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Service Physics Model 9603 X-Ray System** |  |  |
|  | **PARAMETER TABLES** |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| COMPANY | Cal Tech MMRC |   |   |   |   |   |
| CUSTOMER | Bruce B. |  |  |  |   |  |   |
| DATE | 10/15/2019 |  | COMMENT: |  |  |  |   |
| TEST ENGINEER | Zach Mehl |   |   |   |   |   |   |
|  |  |  |  |  |  |  |  |
| Gun Info |   |  |  |  |  |  |
| S/N | N/A |  |  |  |  |  |
| Date Installed | N/A - pre 2017 |  |  |  |  |  |
| Notes | Extra thick copper gasket |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  | **SPOT SIZES** |  |  |
|   | 100 | 200 | 400 | 800 | L1 | L2 | L3 |
| I Out | 1.48 | 4.99 | 9.94 | 19.9 | 4.99 | 9.94 | 19.9 |
| I Fil | 1.12 | 1.13 | 1.14 | 1.15 | 1.13 | 1.14 | 1.14 |
| V 2KV | 2.31 | 2.31 | 2.31 | 2.31 | 2.31 | 2.31 | 2.31 |
| I 2KV | 6.27 | 6.95 | 7.43 | 7.95 | 6.92 | 7.4 | 7.93 |
| VQ | 0.01 | 0.02 | 0.01 | 0.02 | 0.01 | 0.38 | 0.32 |
| VF | 8.42 | 8.48 | 8.43 | 8.56 | 8.4 | 8.41 | 8.63 |

## V1 calibration results

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